



Public Health Assessment for

HIDDEN LANE LANDFILL
STERLING, LOUDOUN COUNTY, VIRGINIA
EPA FACILITY ID: VAD980829030
APRIL 6, 2009

**U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE**

Agency for Toxic Substances and Disease Registry

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment was prepared by ATSDR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6)), and in accordance with our implementing regulations (42 C.F.R. Part 90). In preparing this document, ATSDR has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate.

In addition, this document has previously been provided to EPA and the affected states in an initial release, as required by CERCLA section 104 (i)(6)(H) for their information and review. The revised document was released for a 30-day public comment period. Subsequent to the public comment period, ATSDR addressed all public comments and revised or appended the document as appropriate. The public health assessment has now been reissued. This concludes the public health assessment process for this site, unless additional information is obtained by ATSDR which, in the agency's opinion, indicates a need to revise or append the conclusions previously issued.

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Prepared by:

U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation

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Summary

The Hidden Lane Landfill site is a closed landfill located ¾ mile north of Route 7 in Sterling, Loudoun County, Virginia. Operation of the landfill occurred from 1971 to 1984; from 1981 to 1984 the landfill was permitted to accept building materials. However, the landfill reportedly accepted other materials, including hazardous materials. Testing has identified contamination of certain private drinking water wells adjacent to and near the landfill with chlorinated volatile organic compounds (VOCs). Many affected wells have been fitted with filtration systems to remove VOCs prior to consumption. ATSDR evaluated the limited available information to determine whether exposure to chlorinated VOCs in private well water could result in harmful health effects. ATSDR also considered the possibility for adverse health effects to result from other types of exposure and made recommendations for further sampling that would allow evaluation of such exposures.

On the basis of available data, ATSDR made the following conclusions:

- Drinking or otherwise using properly treated water from a private well contaminated with VOCs from the Hidden Lane Landfill site is not expected to harm people's health. This is because properly operating filtration systems remove the VOCs.
- Drinking or otherwise using untreated or improperly treated water from contaminated private wells for many years could harm people's health.
- The information we need to evaluate potential exposure pathways such as vapor intrusion into homes and trespasser exposures is not available at this time. We are working with the Environmental Protection Agency (EPA) to ensure the information we need is collected during the remedial investigation at the site.
- The information we need to evaluate the potential for the site to pose physical hazards (fire, methane gas production) to the surrounding community is not available at this time. We are working with the EPA to ensure the information we need is collected during the remedial investigation at the site.

ATSDR made the following recommendations about the site:

- EPA should ensure proper operation of the carbon filtration systems on private wells, especially if the system has sulfur odor problems. ATSDR recommends EPA work with its contractors to address the sulfur odor problems in certain well treatment systems.
- ATSDR, EPA, and Loudoun County should work together to encourage residents who have not had their private well tested for contaminants to have the water tested. If the VOC levels in the well water exceed drinking water standards, residents should be informed about the potential hazard of drinking the water without filtering it properly for VOCs.
- EPA should perform adequate groundwater and soil gas sampling to determine if vapor intrusion into nearby homes is a possibility, and take follow-up actions as necessary.
- EPA should monitor the potential for physical hazards (fire and methane gas production) to impact nearby residences.

Purpose and Statement of Issues

The Hidden Lane Landfill site was proposed for the National Priorities List (NPL) on September 19, 2007 and listed on March 19, 2008. The Agency for Toxic Substances and Disease Registry (ATSDR) is required by Congress to conduct public health activities on all sites proposed for the NPL. In this public health assessment, ATSDR evaluates the public health significance of the Hidden Lane Landfill site. ATSDR reviewed available environmental data, potential exposure scenarios, and community health concerns to determine whether adverse health effects are possible. Because of limited data, the health risk evaluation focuses only on potential exposures to chlorinated volatile organic compounds (VOCs) in private well water. We will also discuss the possibility for adverse health effects to result from other types of exposure and make recommendations for further sampling that would allow evaluation of such exposures. This document was previously released for public comment in January 2009; the current version includes public comments received and ATSDR responses in an appendix beginning on page 19.

Background

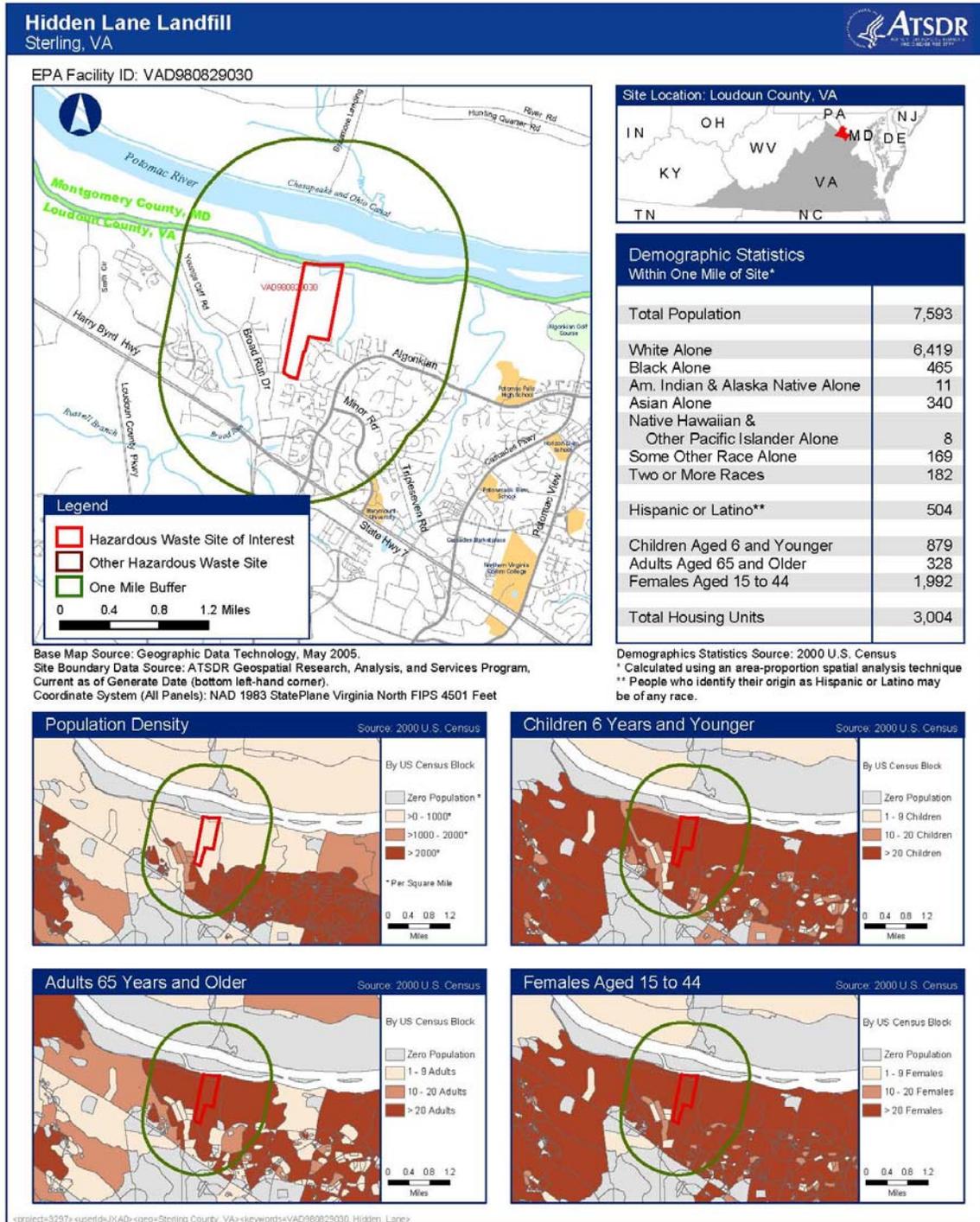
Site Description and History

Background information on the site is taken from site documents [1-3]. The Hidden Lane Landfill site (“the site,” formerly known as the Loudoun County Dump site) is a closed landfill located $\frac{3}{4}$ mile north of Route 7 in Sterling, Loudoun County, Virginia. The location is shown in Figure 1. The landfill is about 30 acres in size on a 147 acre piece of property. The landfill began operation in 1971; from 1981 to 1984 it was permitted as a landfill for building materials. However, the landfill reportedly accepted other materials, including hazardous materials, and the landfill was closed in 1984. In the late 1980s, testing performed by EPA in response to a citizen complaint identified VOC contamination of certain private drinking water wells adjacent to and near the landfill. VOCs detected in the wells included trichloroethene (TCE); 1,1-dichloroethene (1,1-DCE); and/or vinyl chloride (VC). Many affected wells have been fitted with filtration systems to remove VOCs prior to consumption. Because some homeowners did not grant permission for well testing, there may be some untreated contaminated wells being used.

Site Operational History

The landfill, which is unlined, operated from 1971 to 1984. From 1971 to 1981, the landfill accepted a wide range of construction and non-construction wastes without county or Commonwealth approval. The landfill operated from 1981 to 1984 under a debris landfill permit issued by the Commonwealth of Virginia Department of Health (VDH), but the site was forced to close down after it was proven that it was accepting wastes other than construction and demolition debris. A 2-foot clay cap was placed on top of the landfill in 1984. In 1988, a site inspection showed semi-volatile organic compounds and VOCs in the groundwater; two residences with wells were notified of VOC detections and advised to install water filtration units. The same year, Loudoun County installed monitoring wells and a methane gas mitigation system along the east border of the landfill, because methane was determined to be affecting homes in the Countryside neighborhood.

Figure 1. Site Location and Demographics



In 2005, testing by the Loudoun County Health Department, part of the VDH, found 16 residential wells in the Broad Run Farms neighborhood with detections of TCE above the maximum contaminant level (MCL) of 5 micrograms per liter ($\mu\text{g/L}$). In each home where TCE was detected and the homeowner granted permission, the Commonwealth of Virginia Department of Environmental Quality (DEQ) installed water filtration systems. DEQ was maintaining the filtration systems as well as confirming proper operation by semiannual testing of the water going in and coming out of the filtration systems. The U.S. Environmental Protection Agency (EPA) proposed the Hidden Lane Landfill to the NPL in September 2007, and the site was listed in March 2008. Testing and maintenance of the residential filtration systems has transitioned over to EPA, and EPA has instituted quarterly monitoring as of fall of 2008.

EPA is currently planning a remedial investigation to fully characterize the nature and extent of contamination as well as the likely flow direction of the groundwater. In addition to VOC contamination of groundwater, the landfill may be the source of other contaminants, and there may be additional means by which people could come into contact with contaminants (termed “exposure pathways.”) However, only limited data on contamination of soil, soil gas, or other environmental media are available. At this time, sufficient information does not exist to allow a full assessment of health impacts from all exposure pathways at the site. Therefore, *this public health assessment will focus on potential exposure of the public to the VOCs that have been detected in private well water.* This document discusses other potentially important exposure pathways and recommends additional sampling that will allow evaluation of their impact on public health.

Demographics

Figure 1 includes demographic information for the site. In 2000, there were almost 7,600 people within a 1-mile radius of the landfill, with about 85% white; 6% black; 4% Asian; and less than 3% other race, two or more races, or American Indian/Alaska Native, Native Hawaiian/Other Pacific Islander. Almost 7% of the population was identified as Hispanic or Latino.

The most affected neighborhood, Broad Run Farms, is much less densely populated than the east side of the landfill. The neighborhood comprises about 350 properties, but the area of suspected VOC contamination, where well water sampling was performed, includes less than 100 homes, and many of the properties sampled showed no detections of contamination. According to local citizens, the demographic makeup of the Broad Run Farms neighborhood is mostly white.

Land and Natural Resource Use

The landfill is currently a raised section of land bordered by Persimmon Drive to the south, private homes in the Broad Run Farms subdivision to the west, private homes in the Countryside subdivision to the east, and undeveloped land in a floodplain leading to the Potomac River to the north. The landfill rises about 50 feet above the surrounding land, which is fairly flat. Some home lots are within 100 feet of the landfill.

Homes in the Broad Run Farms subdivision are all served by private wells. Several of these wells have been identified as containing TCE and have had filtration systems installed. The Virginia DEQ was performing semiannual testing of the wells to ensure that filtration systems are working properly; EPA has taken over this function as well as maintenance of the systems.

Homes in the Countryside development are on municipal water; this system's raw water intake is located on the Beaverdam Reservoir in eastern Loudoun County, about 8 miles upstream of the site. At least one home in the Countryside development was reportedly affected by methane gas generated at the landfill. Anecdotal reports stated that this home had to be temporarily evacuated due to the presence of methane in the home's basement at a level exceeding the lower explosive limit. In September 1988, Loudoun County installed 14 permanent landfill gas monitoring wells between the landfill and the Countryside development which has reportedly mitigated this problem [4].

Groundwater at the site is thought to naturally flow north-northeast towards the river. However, the pumping action of private wells in Broad Run Farms is likely affecting groundwater flow so that it locally flows towards the wells.

Discussion

Data Used

A major source of data evaluated in this report is the hazard ranking system (HRS) package; references listed in the package were provided by EPA Region 3. In addition, DEQ provided results of private well sampling data taken over time by the Loudoun County Health Department. Data evaluated included:

- Results of home well testing reported in the 1989 Site Inspection [2];
- Results of private well sampling collected in October 2005 for the Integrated Assessment [3];
- Results of private well sampling collected from June 2005 until August 2007 for ongoing monitoring [5].
- Limited data are available on potential contamination at the landfill itself. These include a few samples of soil, groundwater, leachate (surface water collected after it infiltrates through the body of the landfill), and soil gas (gas present in the gaps between soil particles above the water table) [3,4,6].

ATSDR visited the site¹ to better understand the physical setting of the site and its relationship to the people living and working nearby. During the site visit, we learned the following information:

- The landfill has no fence and is accessible from the main gate by the public; reportedly, signs of human activity (debris, empty beverage containers, all-terrain vehicle tracks) are present on the site.
- Private home lots east and west of the landfill are located within 100-200 feet of sloped walls. The sloped walls of the landfill are quite steep, making direct access from private lots difficult.

¹ATSDR staff (Jill Dyken, Youlanda Outin, Karl Markiewicz, Deborah Burgin, and Ryan Costello) visited the site on August 19, 2008 accompanied by the EPA community involvement coordinator Larry Johnson.

- EPA officials indicated that the top of the landfill was covered in grasses and small trees/shrubs.
- ATSDR heard anecdotal reports that vents in several locations release methane gas generated by the landfill and that fires have been present beneath the landfill.
- Local residents indicated that several people have problems with their carbon filtration systems. The water is fine for 2-4 weeks after maintenance, but then a strong odor of rotten eggs develops in the water. We heard anecdotal reports that some residents have bypassed the filtration systems due to the odor problem. EPA has since begun to address these issues [personal communication, Fred MacMillan, U.S. Environmental Protection Agency, December 9, 2008].

Evaluation Process

The typical process by which ATSDR evaluates the potential for adverse health effects to result from exposure to site contaminants will be described briefly in this section.

- When presented with results of comprehensive environmental sampling for chemicals, ATSDR reduces the number of contaminants that need to be evaluated by screening the results for each chemical against *comparison values* (CVs)—concentrations of chemicals in the environment (air, water, or soil) below which no adverse human health effects would ever be expected to occur. If a contaminant is present at a level higher than the corresponding CV, it does not mean that adverse health effects will occur; the contaminant is merely retained for the next step of evaluation.
- The next step of evaluation focuses on identifying which chemicals and exposure situations could be a health hazard. We calculate *exposure doses*—estimated amounts of a contaminant that people come in contact with and get into their bodies, on an equivalent body weight basis—under specified exposure situations, typically starting with “worst case” type assumptions to obtain the highest dose that could be expected. Each calculated exposure dose is compared against the corresponding *health guideline*, typically an ATSDR minimal risk level (MRL) or EPA Reference Dose (RfD), for that chemical. Health guidelines are considered safe doses; that is, if the calculated dose is at or below the health guideline, no adverse health effects would be expected.
- If the “worst case” exposure dose for a chemical is greater than the health guideline, then the exposure dose may be refined to more closely reflect actual exposures that occurred or are occurring at the site. The exposure dose is then compared to known health effect levels (for both cancer and non-cancer effects) identified in ATSDR’s toxicological profiles. *These comparisons are the basis for stating whether or not the exposure presents a health hazard.*

For the exposure evaluation of this public health assessment, we will consider only the VOCs in the private well water. These compounds have been detected in area private wells, and comprehensive data on other potential contaminants of concern and other exposure pathways are not available at this time.

Exposure Pathways and Contaminants of Concern

As described previously, this PHA focuses on exposure to VOCs in private well water. People who use contaminated well water could be exposed to VOCs in several ways:

- *Ingestion:* People could drink the water or eat food prepared using the water.
- *Inhalation:* People could breathe in VOCs that volatilize (move into the air) from well water during showering, bathing, or other household use.
- *Dermal Exposure:* People could absorb VOCs through their skin during showering, bathing, or other use.

Ingestion exposure is often the most significant source of exposure to hazardous substances from a site. In the case of VOC contamination, however, inhalation and dermal exposures can make a significant contribution to the total exposure dose. A precise estimate of these non-ingestion exposures is seldom achievable. A common estimation is that non-ingestion exposures (inhalation plus dermal) yield a contaminant dose comparable to the ingestion dose [8]. In the evaluation performed in this public health assessment, we doubled ingestion exposure doses (estimated using measured water VOC concentrations, default assumptions for amount of water consumed per day, and other exposure parameters) to account for additional exposure from inhalation and dermal exposures.

The most comprehensive well sampling events were the EPA 2005 Integrated Assessment and DEQ monitoring conducted from 2005-2007 [3,5]. The EPA sampling included tests on private well water from 40 wells, 12 of which had some sort of filtration system on the well water. For wells with filtration systems, samples were collected before and after the water entered the filter. DEQ monitoring included 26 private wells with filtration systems installed; most of these were sampled multiple times. Samples were collected both before and after the water entered the filter.

There was some overlap in wells tested by EPA and DEQ, but since specific well information was not given, the results were not combined. Data from these sampling events were used to estimate the extent of potential exposures to private well users at the site. It should be noted that VOC levels could have been higher in the past, while the landfill was operating and before testing of the private wells began in the 1980s. The highest levels of VOCs found were:

- TCE: 130 µg/L. This exceeds the MCL for TCE of 5 µg/L. In DEQ sampling, 13 out of 26 wells tested had average TCE concentrations exceeding the MCL entering the filtration unit. In the EPA sampling, 9 out of 40 wells had incoming TCE concentrations exceeding the MCL.
- 1,1-DCE: 8 µg/L. This slightly exceeds the MCL for 1,1-DCE of 7 µg/L. 1,1-DCE was found mainly in wells containing high levels of TCE. DCE is a breakdown product of TCE.
- Vinyl chloride (VC): 2.8 µg/L. This slightly exceeds the MCL for VC of 2 µg/L. In all the sampling, there was only one detection of VC, a breakdown product of TCE.
- 1,1-Dichloroethane: 9 µg/L. There is no MCL or ATSDR comparison value for 1,1-dichloroethane. The highest level does exceed the EPA Region 3 risk-based concentration of 2.4 µg/L. In all the sampling, there was only one detection of this substance.

In almost all cases, post-carbon filter samples from these wells had no detections of these contaminants, indicating that the filtration systems were functioning properly (EPA sampling at one residence indicated an improperly functioning filter). *As long as the carbon filtration*

systems function properly, people will not be exposed to VOCs through drinking, bathing, or other household use. However, ATSDR did hear reports that some systems did not appear to be functioning properly or that some residences were not using their filtration system due to odor problems. To assess whether this could pose a hazard, we estimated potential exposures to VOCs as if no filtration was occurring.

Potential Impact of TCE Exposure

TCE exposures were estimated using the maximum detected TCE concentration—130 µg/L (or 0.13 mg/L). The maximum value was used to estimate a “worst case” exposure dose, that of a child drinking the highest concentration every day. Assuming a one-year old child weighing 10 kg (22 pounds) drinks one liter of water containing the highest concentration of TCE per day, and multiplying this dose by a factor of 2 to account for additional exposure from breathing in water and getting it on skin during bathing, the daily dose of TCE is estimated as 2 times 0.13 mg/L times 1 L divided by 10 kg body weight = 0.026 mg/kg/day. This dose is several orders of magnitude smaller than effect levels seen in animal studies [9]. However, some epidemiologic studies have suggested that drinking TCE at levels similar to the maximum at this site for long periods is associated with skin problems, liver and kidney damage, impaired immune system function, and impaired fetal development in pregnant women [9]. These studies are controversial because there were other contaminants present in the water which may have caused the observed health effects, some studies had too few people in them, and TCE effect levels were not well-defined [9]. Although still unlikely, if people drank the most highly contaminated water at the site for several years, they may have an increased risk of the above health effects.

The International Agency for Research on Cancer (IARC) has determined that TCE is a probable human carcinogen [10]. EPA is currently reviewing the cancer slope factor for this substance and has proposed cancer slope factors ranging from 0.02 to 0.4 (mg/kg/day)⁻¹ [11]. In ATSDR’s evaluation, we used the highest (most protective) cancer slope factor because the affected population might contain people especially sensitive to TCE’s effects. Lifetime excess cancer risk is estimated by assuming the maximum daily adult dose (a person weighing 70 kilograms drinking 2 liters of water containing TCE at the maximum concentration) continues for a 70-year lifetime. (The potential exposure is also doubled to account for inhalation and dermal exposures associated with use of the well water.) Using an oral cancer slope factor of 0.4 (mg/kg/day)⁻¹, the predicted theoretical increased risk of cancer would be moderate to high.

This evaluation indicates that continuing to drink untreated private well water may increase the risk of adverse health effects. However, many wells on the site had contaminant levels much lower than the maximum discussed above, too low to cause observable health effects. To our knowledge, all homeowners whose wells were found to contain elevated levels of TCE have had carbon filtration systems installed, effectively disrupting this exposure pathway. It is impossible to tell whether past exposures could lead to the above long-term health effects without more specific information about how long people were drinking contaminated water and the levels of contaminants in each well over time. The risk to the residents who chose not to have their water tested or who may not be using the filtration system properly depends on the actual contaminant levels in the well and each resident’s specific exposure scenario.

Potential Impact of 1,1-DCE Exposure

Using the highest concentration of 1,1-DCE detected in private well water (8 µg/L), the “worst case” dose, that of a child drinking the highest concentration every day, is estimated at 0.0016 mg/kg/day. This is lower than the health guideline for 1,1-DCE (ATSDR’s minimal risk level of 0.009 mg/kg/day) and therefore would not be expected to result in any observable adverse health effects [12].

Potential Impact of Vinyl Chloride Exposure

Using the highest concentration of VC detected in private well water (2.8 µg/L), the “worst case” dose, that of a child drinking the highest concentration every day, is estimated at 0.0006 mg/kg/day. This is lower than the health guideline for VC (ATSDR’s minimal risk level of 0.003 mg/kg/day) and therefore would not be expected to result in any observable adverse health effects [13].

The International Agency for Research on Cancer (IARC) has determined that vinyl chloride is a known human carcinogen. Lifetime excess cancer risk is estimated by assuming the maximum daily adult dose (a person weighing 70 kilograms drinking 2 liters of water containing vinyl chloride at the maximum concentration) continues for a 70-year lifetime. (The potential exposure is also doubled to account for inhalation and dermal exposures associated with use of the well water.) Using an oral cancer slope factor for lifetime exposure of $1.4 \text{ (mg/kg/day)}^{-1}$, the predicted theoretical increased risk of cancer would be low.

Potential Impact of 1,1-Dichloroethane Exposure

Using the highest concentration of 1,1-dichloroethane detected in private well water (9 µg/L), the “worst case” dose, that of a child drinking the highest concentration every day, is estimated at 0.0018 mg/kg/day. This dose is several orders of magnitude lower than effect levels observed in animal studies, and therefore it is unlikely that such a dose would result in any observable adverse health effects [14].

Summary – Health Impact of Drinking Private Well Water

As long as the private well water does not contain elevated levels of VOCs or the water is filtered properly before consumption, there is no risk of developing adverse health effects from exposure to well water. However, if people are drinking untreated well water containing the highest levels of TCE, they may have an increased risk of observable adverse health effects that could include skin problems, liver or kidney damage, impaired immune system function, impaired fetal development in pregnant women, or cancer. We recommend all potentially affected wells be identified and treated with carbon filtration systems if necessary.

Potential Exposure Pathways

Vapor Intrusion

If VOC levels are high enough in groundwater and the groundwater is close enough to the surface, sometimes VOCs can move through the soil above the water table to reach the air. In some cases, the VOCs encounter cracks or lines that bring the contaminants into home interiors, such as basements, and the contaminant can build up inside. This is known as *vapor intrusion*, and in some cases vapors from contaminants can reach levels that are of health concern. At this point, we don't know whether vapor intrusion is a potential problem for homes near the Hidden Lane Landfill. A landfill gas monitoring system of 14 wells was installed in 1988 along the east side of the landfill (near Countryside), and limited soil gas samples collected showed the presence of chlorinated VOCs as well as some other volatile compounds [4]. Levels of VOCs in soil gas in other areas of the site are not known. ATSDR will work with EPA to ensure that proper characterization of groundwater and soil gas contaminant levels around the landfill is conducted so that evaluation of this potential exposure pathway can occur.

Trespassers/Recreational

Due to the unrestricted access to the landfill, trespassers could come into contact with hazardous substances or physical hazards at the landfill itself, especially if the clay cap is disturbed. ATSDR recommends that EPA include plans to sample landfill soil and subsurface soil for a full range of contaminants to determine the potential hazard associated with trespasser or recreation exposures at the landfill. It may be more practical to prevent access completely by improving the gate leading into the landfill access road (the steep slopes of the landfill make access by other routes difficult).

Physical Hazards

ATSDR heard anecdotal reports that areas of the landfill are occasionally on fire or smoldering, especially when the clay cap is penetrated. This could pose a physical hazard to trespassers or nearby homes. At one time in the past, methane gas (from decomposition in the landfill) was reported at levels indicating an explosive risk in the neighborhood east of the landfill (Countryside). ATSDR will review information about the gas mitigation system to assess whether this is sufficiently protective for all residences around the landfill.

Past Exposures

Very little is known about the ultimate source of VOC contamination, when the source material was added to the landfill, or how the contamination moved through the groundwater initially. Past exposures to VOCs in groundwater could have been higher or lower than indicated in more recent sampling. The health risk from any past exposure to VOCs in groundwater cannot be estimated.

Children's Health Considerations

ATSDR recognizes that infants and children might be more vulnerable than adults to exposures in communities with contaminated air, water, soil, or food. This potential vulnerability results from the following factors: 1) children are more likely to play outdoors and bring food into contaminated areas; 2) children are shorter and therefore more likely to contact dust and soil; 3) children's small size results in higher doses of chemical exposure per kg of body weight; and

4) developing body systems can sustain permanent damage if toxic exposures occur during critical growth stages. Because children depend completely on adults for risk identification and management decisions, ATSDR is committed to evaluating their special interests at the site.

Because small children are potentially exposed to contaminated private well water, ATSDR estimated exposures based on a 1-year old child. A small child would have a higher exposure dose than an adult because of the child's smaller body weight; therefore conclusions based on exposure doses estimated for children would be protective for adults as well.

Health Outcome Data

Health outcome data can give a more thorough evaluation of the public health implications of a given exposure. Health outcome data can include mortality information (e.g., the number of people dying from a certain disease) or morbidity information (e.g., the number of people in an area getting a certain disease or illness). The review is most effective when (1) a completed human exposure pathway exists, (2) contaminant levels are high enough to result in measurable health effects, (3) enough people are affected for the health effect to be measured, and (4) a database is available to identify disease rates for populations of concern.

A review of health outcome data was not performed for this site. As soon as contamination of well water was discovered, wells were fitted with filtration systems, so this exposure pathway is incomplete (that is, people are not being exposed to contaminants). We don't have any information regarding past VOC exposure (although we can assume exposure was not occurring before the landfill began operating in 1971). Even if we knew the levels of past exposure, the number of potentially exposed people would be too small to allow us to detect statistical differences in disease rates.

Community Health Concerns

In producing a public health assessment, ATSDR attempts to respond to communities' health concerns about the site. ATSDR has begun to collect health concerns. ATSDR met with two community members in August 2008, and EPA staff conveyed the community health concerns they were aware of. ATSDR will inform the community how they can share any additional health concerns by placing a notice in the homeowners' association newsletter and by attending community meetings related to the site. The following lists the health concerns about VOC exposure ATSDR has collected to date.

Concern: When my filter is changed out, it works well for a couple weeks and then a smell of rotten eggs develops in the water. Is this harmful? Is the filter operating properly?

Response: ATSDR heard reports that several homeowners had this same problem, and we have since been informed that EPA has begun to address these issues [personal communication, Fred MacMillan, U.S. Environmental Protection Agency, December 9, 2008]. Although it is not possible to know for sure without inspecting your system, it could be that bacteria are growing on the surface of the carbon used in the filtration system. Possible microbiological contamination is a reason the water is treated with ultraviolet (UV) radiation after the water exits the carbon filter. If bacteria are of the sulfur-reducing class, they may grow on naturally occurring sulfate

minerals to produce hydrogen sulfide gas, which has a characteristic “rotten egg” smell. The hydrogen sulfide would not be removed by the UV radiation.

Hydrogen sulfide at very low levels can give water an unpleasant smell and taste. The lowest level a person can smell varies widely; it can range from 0.5 to 300 parts per billion (ppb) of hydrogen sulfide in air [15]. Also, your sense of smell becomes desensitized to hydrogen sulfide after a short period of time, so you might become unaware of its presence. Very high levels of hydrogen sulfide (greater than 500,000 ppb) can be fatal within just a few breaths, and lower concentrations (10,000 to 15,000 ppb) may result in symptoms such as eye and respiratory irritation [15]. Residents near industries emitting hydrogen sulfide reported nasal symptoms, cough, or increased emergency room visits for respiratory symptoms [15]. It is unlikely that you would experience any of these symptoms, since even the elevated level of hydrogen sulfide you could smell in well water would be much lower than the level causing these effects and since the hydrogen sulfide odor takes a while to build up in the water before you can smell it. However, it would be best if the cause of the odor problem was identified and addressed, especially since hydrogen sulfide in water can stain or corrode plumbing and sulfur-reducing bacteria can clog plumbing systems [16].

The presence of bacteria in the system does not necessarily diminish the efficacy of the filtration system in removing TCE and other VOCs. The sampling data collected in 2005-2007 indicated that the filtration systems were effective in removing VOCs from well water [5]. However, we don't know the exact circumstances under which the samples were collected (that is, was the sulfur odor present or not?). If the odor problem is not resolved, it would be prudent to collect pre- and post-filtration well water samples during a period of odor production to confirm that TCE and other VOCs are being removed. Such sampling is important because you would not be able to smell the concentrations of VOCs in the water if they broke through the filtration system. It would also be prudent to sample for hydrogen sulfide in the air during the water sampling to document the levels and make sure they aren't too high.

Concern: Could any of the following be caused by exposure to TCE or other VOCs in my well water? Sudden dizziness, extreme fatigue, dry cough, respiratory irritation, difficulty breathing and swallowing, cancer?

Response: To reiterate, if the filtration system on your well is functioning properly, it should be removing all VOCs and you will not suffer any adverse health effects from exposure. TCE exposure has been associated with some of the symptoms listed, however, so additional information is provided here.

Dizziness and Fatigue: TCE can cause people to become dizzy and sleepy and, at very high levels, lose consciousness; in fact, TCE was once used as an anesthetic for surgery [12]. The levels of TCE in air that caused these effects were high, tens or hundreds of parts per million. The concentration of TCE in well water at this site would translate to, at most, parts per billion levels in air (one ppb is one one-thousandth as much as one ppm). This level of air exposure would not be expected to cause a measurable amount of dizziness or drowsiness.

Dry cough, respiratory irritations, difficulty breathing or swallowing: At very high concentrations, TCE can be irritating to the skin or to mucous membranes after breathing it in. However, those levels are not expected from the exposures occurring at this site. Some animal studies have indicated changes in lung cells, considered a “less serious” effect, in mice and rats exposed to hundreds of ppm of TCE. Again, these changes would not be expected at the levels of TCE present at this site. As described earlier, some people at the site have reported an odor of rotten eggs in their water. This might be indicative of sulfur-reducing bacteria which are producing hydrogen sulfide. Studies have shown that some people exposed to hydrogen sulfide have reported respiratory symptoms [15]. Further investigation of this question is reasonable.

Cancer: TCE is classified as a probable human carcinogen. There are some studies showing an association of long-term exposure to TCE with leukemia rates; however, these studies are not definitive and more investigation is needed. Animal experiments on rats and mice have shown that TCE exposure was associated with tumors of the lungs, liver, and testes. ATSDR recommends people not drink TCE-contaminated water due to an increased risk of cancer. However, the potential for probable exposures to result in cancer in local residents is small.

Conclusions

- As long as contaminated private well water is treated with a properly operating filtration system, no adverse health effects are expected from consumption and household use of the water.
- If persons are using and consuming untreated or improperly treated contaminated water, they have an increased risk of developing adverse noncancer and cancer health effects due to TCE exposure.
- Potential exposure pathways including vapor intrusion into homes and trespasser exposures could not be evaluated at this time due to limited data.
- The site may pose physical hazards (fire, methane gas production) to the surrounding community that warrant further investigation.

Recommendations

- EPA should ensure proper operation of the carbon filtration systems on private wells, especially if the system has sulfur odor problems. ATSDR recommends EPA work with its contractors to address the sulfur odor problems in certain well treatment systems.
- ATSDR, EPA, and Loudoun County should work together to encourage residents who have not had their private well tested for contaminants to have the water tested. If the VOC levels in the well water exceed drinking water standards, residents should be informed about the potential hazard of drinking the water without filtering it properly for VOCs.
- EPA should perform adequate groundwater and soil gas sampling to determine if vapor intrusion into nearby homes is a possibility, and take follow-up actions as necessary.
- EPA should monitor the potential for physical hazards (fire and methane gas production) to impact nearby residences.

Public Health Action Plan

- EPA is currently working with homeowners and contractors to ensure proper operation and maintenance of carbon filtration systems and to address odor issues.
- ATSDR is available for public health consultation with EPA and Loudoun County as they develop a program for periodic well monitoring to ensure contaminated wells are identified and treated.
- ATSDR will work with EPA to ensure that proper characterization of groundwater and soil gas contaminant levels around the landfill is conducted. This will enable ATSDR to evaluate exposures associated with potential vapor intrusion into nearby homes.
- EPA will further characterize contaminant levels at the site, as well as physical hazards, as part of its remedial investigation (RI).
- ATSDR will review EPA's remedial investigation data to evaluate the potential for vapor intrusion, exposures associated with trespassing on the site, and physical hazards. If public health issues are identified with these exposure pathways, ATSDR may release a second document to the public summarizing the findings and making public health recommendations.

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Appendix A. Public Comments and Responses

This public health assessment was available for public review and comment at Galilee United Methodist Church in Sterling, VA; the Cascades Library in Potomac Fall, VA; and the U.S. Environmental Protection Agency offices in Philadelphia, PA from January 19, 2009, through February 27, 2009. The document also was available for viewing or downloading from the ATSDR Web site.

The public comment period was announced to local media outlets. The health consultation also was sent electronically to federal, state, and local officials and involved members of the public. Only one comment was received, from the Loudoun County Health Department. (The public comment version of this public health assessment incorporated comments on an initial draft that were provided by federal, state, and local officials.)

Comment from the Loudoun County Health Department:

The Environmental Protection Agency should consider an option of providing public water to areas with groundwater contamination. The Loudoun County Health Department considers public water to be a sustainable long term solution. When properly maintained and tested, water filtration systems will provide safe adequate drinking water to the end user. However, without proper maintenance and testing the water filtration systems may not be adequate. In addition, private wells that are not currently contaminated with TCE may be contaminated in the future. Without a rigorous testing schedule for all wells in the area, it may not be possible to predict if wells in the area will become contaminated in the future.

Response:

Thank you for your comment. As stated in the public health assessment, ensuring that private well water is properly treated protects the public from harmful exposures to volatile organic compounds in drinking and household use of private well water. However, ATSDR agrees that replacing private wells with public water would protect the community from these exposures and avoid the need for ongoing maintenance of filtration systems on private wells. This action would address the most likely source of exposure to site contaminants; however ATSDR continues to recommend further investigation to determine the potential for harmful exposures from other potential exposure pathways, including vapor intrusion and trespassing on the landfill site.

Appendix B. ATSDR Glossary of Environmental Health Terms

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal public health agency with headquarters in Atlanta, Georgia and 10 regional offices in the United States. ATSDR's mission is to serve the public by using the best science, taking responsive public health actions and providing trusted health information to prevent harmful exposures and diseases related to toxic substances. ATSDR is not a regulatory agency, unlike the U.S. Environmental Protection Agency (EPA), which is the federal agency that develops and enforces environmental laws to protect the environment and human health.

This glossary defines words used by ATSDR in communications with the public. It is not a complete dictionary of environmental health terms. If you have questions or comments, call ATSDR's toll-free telephone number, 1-888-42-ATSDR (1-888-422-8737).

Acute

Occurring over a short time [compare with chronic].

Acute exposure

Contact with a substance that occurs once or for only a short time (up to 14 days) [compare with intermediate duration exposure and chronic exposure].

Adverse health effect

Changes in body function or cell structure that might lead to disease or health problems.

Ambient

Surrounding (for example, ambient air).

Analyte

A substance measured in the laboratory. A chemical for which a sample (such as water, air, or blood) is tested in a laboratory. For example, if the analyte is mercury, the laboratory test will determine the amount of mercury in the sample.

Background level

An average or expected amount of a substance or radioactive material in a specific environment, or typical amounts of substances that occur naturally in an environment.

Biota

Plants and animals in an environment. Some of these plants and animals might be sources of food, clothing, or medicines for people.

Cancer

Any one of a group of diseases that occurs when cells in the body become abnormal and grow or multiply out of control.

Cancer risk

A theoretical risk of for getting cancer if exposed to a substance every day for 70 years (a lifetime exposure). The true risk might be lower.

Central nervous system

The part of the nervous system that consists of the brain and the spinal cord.

CERCLA [see Comprehensive Environmental Response, Compensation and Liability Act of 1980]

Chronic

Occurring over a long time (more than 1 year) [compare with acute].

Comparison value (CV)

Calculated concentration of a substance in air, water, food, or soil that is unlikely to cause harmful (adverse) health effects in exposed people. The CV is used as a screening level during the public health assessment process. Substances found in amounts greater than their CVs might be selected for further evaluation in the public health assessment process.

Completed exposure pathway [see exposure pathway].

Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA)
CERCLA, also known as Superfund, is the federal law that concerns the removal or cleanup of hazardous substances in the environment and at hazardous waste sites. ATSDR, which was created by CERCLA, is responsible for assessing health issues and supporting public health activities related to hazardous waste sites or other environmental releases of hazardous substances.

Concentration

The amount of a substance present in a certain amount of soil, water, air, food, blood, hair, urine, breath, or any other media.

Contaminant

A substance that is either present in an environment where it does not belong or is present at levels that might cause harmful (adverse) health effects.

Curie

A measure of radioactive activity. A curie is the amount of a radioactive substance that will have 37,000,000,000 radioactive decays in one second. One gram of radium-226 is one curie.

Dermal

Referring to the skin. For example, dermal absorption means passing through the skin.

Dermal contact

Contact with (touching) the skin [see route of exposure].

Detection limit

The lowest concentration of a chemical that can reliably be distinguished from a zero concentration.

Disease registry

A system of ongoing registration of all cases of a particular disease or health condition in a defined population.

Dose (for non-radioactive chemicals)

The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An “exposure dose” is how much of a substance is encountered in the environment. An “absorbed dose” is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.

Dose (for radioactive chemicals)

The radiation dose is the amount of energy from radiation that is actually absorbed by the body. This is not the same as measurements of the amount of radiation in the environment.

Environmental media

Soil, water, air, biota (plants and animals), or any other parts of the environment that can contain contaminants.

Environmental media and transport mechanism

Environmental media include water, air, soil and biota (plants and animals). Transport mechanisms move contaminants from the source to points where human exposure can occur. The environmental media and transport mechanism is the second part of an exposure pathway.

EPA

United States Environmental Protection Agency.

Epidemiology

The study of the distribution and determinants of disease or health status in a population; the study of the occurrence and causes of health effects in humans.

Exposure

Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term [acute exposure], of intermediate duration, or long-term [chronic exposure].

Exposure pathway

The route a substance takes from its source (where it began) to its end point (where it ends) and how people can come into contact with (or get exposed to) it. An exposure pathway has five parts: a source of contamination (such as an abandoned business); an environmental media and transport mechanism (such as movement through groundwater); a point of exposure (such as a private well); a route of exposure (eating, drinking, breathing, or touching) and a receptor

population (people potentially or actually exposed). When all five parts are present, the exposure pathway is termed a completed exposure pathway.

Feasibility study

A study by EPA to determine the best way to clean up environmental contamination. A number of factors are considered, including health risk, costs and what methods will work well.

Groundwater

Water beneath the earth's surface in the spaces between soil particles and between rock surfaces [compare with surface water].

Hazard

A source of potential harm from past, current, or future exposures.

Hazardous waste

Potentially harmful substances that have been released or discarded into the environment.

Health consultation

A review of available information or collection of new data to respond to a specific health question or request for information about a potential environmental hazard. Health consultations are focused on a specific exposure issue. Health consultations are therefore more limited than a public health assessment, which reviews the exposure potential of each pathway and chemical [compare with public health assessment].

Indeterminate public health hazard

The category used in ATSDR's public health assessment documents when a professional judgment about the level of health hazard cannot be made because information critical to such a decision is lacking.

Incidence

The number of new cases of disease in a defined population over a specific time period [contrast with prevalence].

Ingestion

The act of swallowing something through eating, drinking, or mouthing objects. A hazardous substance can enter the body this way [see route of exposure].

Inhalation

The act of breathing. A hazardous substance can enter the body this way [see route of exposure].

Intermediate duration exposure

Contact with a substance that occurs for more than 14 days and less than a year [compare with acute exposure and chronic exposure].

mg/kg

Milligram per kilogram.

mg/m³

Milligram per cubic meter; a measure of the concentration of a chemical in a known volume (a cubic meter) of air, soil, or water.

Migration

Moving from one location to another.

Mortality

Death. Usually the cause (a specific disease, condition, or injury) is stated.

National Priorities List for Uncontrolled Hazardous Waste Sites

(National Priorities List or NPL) EPA's list of the most serious uncontrolled or abandoned hazardous waste sites in the United States. The NPL is updated on a regular basis.

National Emission Standards for Hazardous Air Pollutants or NESHAPs

40 CFR Part 61

Subpart H - National Emission Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities Source: [54 FR 51695, Dec. 15, 1989] § 61.92 Standard. Emissions of radionuclides to the ambient air from Department of Energy facilities shall not exceed those amounts that would cause any member of the public to receive in any year an effective dose equivalent of 10 mrem/yr.

No apparent public health hazard

A category used in ATSDR's public health assessments for sites where human exposure to contaminated media might be occurring, might have occurred in the past, or might occur in the future, but where the exposure is not expected to cause any harmful health effects.

No public health hazard

A category used in ATSDR's public health assessment documents for sites where people have never and will never come into contact with harmful amounts of site-related substances.

NPL [see National Priorities List for Uncontrolled Hazardous Waste Sites]

Plume

A volume of a substance that moves from its source to places farther away from the source. Plumes can be described by the volume of air or water they occupy and the direction they move. For example, a plume can be a column of smoke from a chimney or a substance moving with groundwater.

Point of exposure

The place where someone can come into contact with a substance present in the environment [see exposure pathway].

Population

A group or number of people living within a specified area or sharing similar characteristics (such as occupation or age).

Prevalence

The number of existing disease cases in a defined population during a specific time period [contrast with incidence].

Public health action

A list of steps to protect public health.

Public health advisory

A statement made by ATSDR to EPA or a state regulatory agency that a release of hazardous substances poses an immediate threat to human health. The advisory includes recommended measures to reduce exposure and reduce the threat to human health.

Public health assessment (PHA)

An ATSDR document that examines hazardous substances, health outcomes and community concerns at a hazardous waste site to determine whether people could be harmed from coming into contact with those substances. The PHA also lists actions that need to be taken to protect public health [compare with health consultation].

Public health hazard

A category used in ATSDR's public health assessments for sites that pose a public health hazard because of long-term exposures (greater than 1 year) to sufficiently high levels of hazardous substances or radionuclides that could result in harmful health effects.

Public health hazard categories

Public health hazard categories are statements about whether people could be harmed by conditions present at the site in the past, present, or future. One or more hazard categories might be appropriate for each site. The five public health hazard categories are no public health hazard, no apparent public health hazard, indeterminate public health hazard, public health hazard and urgent public health hazard.

Radioisotope

An unstable or radioactive isotope (form) of an element that can change into another element by giving off radiation.

Radionuclide

Any radioactive isotope (form) of any element.

RCRA [See Resource Conservation and Recovery Act (1976, 1984)]

Registry

A systematic collection of information on persons exposed to a specific substance or having specific diseases [see disease registry].

Remedial Investigation

The CERCLA process of determining the type and extent of hazardous material contamination at a site.

Resource Conservation and Recovery Act (1976, 1984) (RCRA)

This Act regulates management and disposal of hazardous wastes currently generated, treated, stored, disposed of, or distributed.

RFA

RCRA Facility Assessment. An assessment required by RCRA to identify potential and actual releases of hazardous chemicals.

Risk

The probability that something will cause injury or harm.

Route of exposure

The way people come into contact with a hazardous substance. Three routes of exposure are breathing [inhalation], eating or drinking [ingestion], or contact with the skin [dermal contact].

Safety factor

Mathematical adjustments for reasons of safety when knowledge is incomplete. For example, factors used in the calculation of doses that are not harmful (adverse) to people. These factors are applied to the lowest-observed-adverse-effect-level (LOAEL) or the no-observed-adverse-effect-level (NOAEL) to derive a minimal risk level (MRL). Uncertainty factors are used to account for variations in people's sensitivity, for differences between animals and humans and for differences between a LOAEL and a NOAEL. Scientists use uncertainty factors when they have some, but not all, the information from animal or human studies to decide whether an exposure will cause harm to people [also sometimes called an uncertainty factor].

SARA [see Superfund Amendments and Reauthorization Act]

Sample

A portion or piece of a whole. A selected subset of a population or subset of whatever is being studied. For example, in a study of people the sample is a number of people chosen from a larger population [see population]. An environmental sample (for example, a small amount of soil or water) might be collected to measure contamination in the environment at a specific location.

Solvent

A liquid capable of dissolving or dispersing another substance (for example, acetone or mineral spirits).

Source of contamination

The place where a hazardous substance comes from, such as a landfill, waste pond, incinerator, storage tank, or drum. A source of contamination is the first part of an exposure pathway.

Statistics

A branch of mathematics that deals with collecting, reviewing, summarizing and interpreting data or information. Statistics are used to determine whether differences between study groups are meaningful.

Substance

A chemical.

Superfund Amendments and Reauthorization Act (SARA)

In 1986, SARA amended CERCLA and expanded the health-related responsibilities of ATSDR. CERCLA and SARA direct ATSDR to look into the health effects from substance exposures at hazardous waste sites and to perform activities including health education, health studies, surveillance, health consultations and toxicological profiles.

Surface water

Water on the surface of the earth, such as in lakes, rivers, streams, ponds and springs [compare with groundwater].

Survey

A systematic collection of information or data. A survey can be conducted to collect information from a group of people or from the environment. Surveys of a group of people can be conducted by telephone, by mail, or in person. Some surveys are done by interviewing a group of people.

Synergistic effect

A biologic response to multiple substances where one substance worsens the effect of another substance. The combined effect of the substances acting together is greater than the sum of the effects of the substances acting by themselves.

Toxicological profile

An ATSDR document that examines, summarizes and interprets information about a hazardous substance to determine harmful levels of exposure and associated health effects. A toxicological profile also identifies significant gaps in knowledge on the substance and describes areas where further research is needed.

Urgent public health hazard

A category used in ATSDR's public health assessments for sites where short-term exposures (less than 1 year) to hazardous substances or conditions could result in harmful health effects that require rapid intervention.

Volatile organic compounds

Organic compounds evaporate readily into the air. VOCs include substances such as benzene, toluene, methylene chloride and methyl chloroform.

Other glossaries and dictionaries:

Environmental Protection Agency
<http://www.epa.gov/OCEPATERMS/>

National Library of Medicine

<http://www.nlm.nih.gov/medlineplus/mplusdictionary.html>